RESEARCH HIGHLIGHT

December 2004

Technical Series 04-131

WATER REUSE STANDARDS AND VERIFICATION PROTOCOL

BACKGROUND

Water reuse involves the use of treated water for additional purposes such as outdoor irrigation, industrial cooling systems and toilet flushing. Water treated for this purpose can come from rain or stormwater, effluent, or wastewater. Depending on the application and risk for human contact, this reused water can be treated to a variety of levels but typically not to levels required for drinking (potable) water.

With the exception of regional rainwater harvesting on the East and West coasts, Canada has had little experience with residential reuse. This is largely due to two factors:

1) the perception of unlimited water availability and low cost for provision of potable water serve as economic and social impediments to water reuse, and

2) the lack of national regulatory standards regarding water quality, plumbing and building code standards act as an obstacle to designers, builders, planners and regulators.

Increasingly, water reuse is being used for industrial, agricultural and residential purposes across the globe, particularly in Australia and southern parts of the U.S. On-site water reuse technologies offer great potential as a water conservation and efficiency measure and as a way to reduce costly infrastructure expansion necessary for water distribution and collection. Reuse and conservation are key ways for water-stressed regions of Canada to reduce their consumption rates—a rate that is the second highest in the world.

In order to initiate and promote national discussion on residential reuse standards, CMHC, as Canada's national housing agency, undertook a project to assess existing standards across the globe and create a draft sample template incorporating these findings. A subsequent workshop of key federal and municipal stakeholders was held to promote awareness and foster further activity.

SCOPE AND METHODOLOGY

For this research project, the consultants determined which countries now reuse water, types of application (including toilet flushing, bathing, showering, laundry, washing and landscape and garden irrigation) and corresponding water quality standards. A second survey examined technology evaluation protocols used for water treatment systems in North America.

The research consultants needed to address two questions: how stringently should reuse water be treated? And should there be different requirements depending on risk of contact? The consultants ascertained the number of agencies with standards for a specific water quality parameter and the most common treatment level for that parameter. It also specified the number of agencies with one standard for all applications (involving both direct and indirect contact with humans), as well as those with separate standards for direct and indirect applications. This information was used for creating a draft Canadian template and to provide a comparison to the current state of the art.

The treatment-technology verification protocols assessed included such elements as dosage, monitoring

Canada

CMHC SCHL
HOME TO CANADIANS

parameters, number and frequency of sampling, duration of testing, influent and effluent characteristics, stress testing and deliverables (such as manuals or installation and troubleshooting guides).

FINDINGS

A. Standards

Standards for water reuse vary greatly around the world, largely because of the wide range of applications for reclaimed water. It is not uncommon for wastewater to be reused for agricultural, industrial or urban municipal purposes, but it is sometimes also used as a potable raw water source in some countries.

Researchers studied a range of residential water reuse standards from North and South America, Europe, Africa, Asia and Australia. Notable among these are standards developed by the World Health Organization and the U.S. Environmental Protection Agency, which are intended to help regulating agencies develop their own water reuse regulations and monitoring programs.

Within the standards examined from the 30 jurisdictions listed in Figure 1, researchers isolated bio-chemical oxygen demand (BOD), total suspended solids (TSS), coliform, turbidity and chlorine as the key biological, biochemical and physical water quality parameters and provided comment on which agencies used these parameters within their standards.

Figure 1—On-site residential applications for reuse water

	On-site residential applications	**Jurisdictions with standard**
Indirect human contact	Toilet flushing	1, 2, 3, 4, 5, 6, 9, 10, 11, 13, 15, 16, 17, 18, 19, 20, 28, 29
	Subsurface irrigation	1, 3
Direct human contact	Landscape irrigation	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 22, 23, 24, 25, 26, 28, 29, 30
	Laundry	3, 9 (commercial laundries only)

Agency reference codes

1 Australian Capital Territory	11 Massachusetts	21 WHO
2 South Australia	12 New Jersey	22 Cyprus
3 New South Wales	13 Texas	23 Spain
4 Victoria	14 Georgia	24 Israel
5 Tasmania	15 Washington	25 Kuwait
6 British Columbia	16 Florida	26 Saudi Arabia
7 Prince Edward Island	17 Wisconsin	27 Italy (national)
8 U.S. EPA	18 Hawaii	28 Japan
9 California	19 Oregon	29 Korea
10 Arizona	20 South Carolina	30 China

B. Verification protocols

Technology-testing protocols enable agencies to verify that the technologies used can bring water up to an acceptable quality standard. There are only a few such protocols in use around the world—nine were reviewed for this report—and not all are intended for wastewater or water reuse applications. Some were to test technologies for disinfection, drinking water treatment or shipboard treatment.

Where sufficient detail exists, the report summarizes each protocol in terms of a number of categories: dosage; duration; number of samples; parameters tested and additional non-conventional parameters; key features of the protocol; influent and effluent characteristics; and literature provided by the manufacturer, such as installation, operation and maintenance manuals.

FOLLOW-UP WORKSHOP: RECOMMENDATIONS AND PROPOSED CRITERIA

A. Recommended standards

The findings of this project were presented to representatives of Health Canada, Environment Canada, the National Research Council, Agriculture Canada, numerous academic institutions, the Canadian Standards Association, the Bureau de normalisation du Québec, provincial health inspectors and on-site regulators, and the Canadian Water and Wastewater Association at a workshop in June, 2003.

2007-00611

Figure 2—Proposed Canadian standards compared to global standards

	Toilet flushing, Subsurface irrigation Low risk			Surface landscape irrigation, Laundry High risk		
Biochemical Oxygen Demand (BOD)—mg/L						
Proposed Canadian standard	≤30			≤10		
Jurisdictions with standards...	Lower	Same	Higher	Lower	Same	Higher
	10	5	1	2	11	7
Total Suspended Solids (TSS)—mg/L						
Proposed Canadian standard	<30			<10		
Jurisdictions with standards...	Lower	Same	Higher	Lower	Same	Higher
	7	6	0	7	2	4
Turbidity—NTU						
Proposed Canadian standard	≤5*			≤2		
Jurisdictions with standards...	Lower	Same	Higher	Lower	Same	Higher
	14	0	0	0	11	4
Total coliform—CFU/100 mL-MPN/100 mL						
Proposed Canadian standard	≤200 CFU/100 mL			≤1-<2.2 CFU/100 mL		
Jurisdictions with standards...	Lower	Same	Higher	Lower	Same	Higher
	10	2	0	0	0	15
Fecal coliform—CFU/100 mL						
Proposed Canadian standard	≤200			<1		
Jurisdictions with standards...	Lower	Same	Higher	Lower	Same	Higher
	16	3	1	0	3	12
Chlorine residual						
Proposed Canadian standard				≥1		
Jurisdictions with standards...				Lower	Same	Higher
				0	5	4

Based on the survey results presented, the workshop proposed two sets of standards: a two-tiered standard distinguishing high-risk and low-risk criteria, plus a "moderate-risk" standard, targeted at a specific reuse application for toilet flushing only.

Participants advocated redundancy in all critical treatment components, so that the failure of a single component would not compromise the entire system. (Alternatively, there could be a fail-safe mechanism that shut the entire system down and activate an alarm in the event of component failure.)

* Although no standard was identified, the author took the liberty of proposing ≤5.

CONCLUSION: IMPLICATIONS FOR THE HOUSING INDUSTRY

This report and the June 2003 workshop were undertaken to foster national interest and discussion about residential water reuse in Canada. This report provides a clear snapshot of the current regulatory climate across the globe.

Since the report appeared, a number of legislative and regulatory bodies related to the housing industry have taken note of these recommendations. The Canadian Standards Association has recently recommended the

creation of a technical steering committee to address non-potable water systems. Discussions are also underway regarding the potential for creation of national reuse water quality guidelines. National guidelines and standards addressing these two areas will serve to promote effective water reuse and stimulate technology development in Canada, allowing Canada to become a world leader in this new and growing area.

CMHC Project Manager: Cate Soroczan

Consultant: NovaTec Consultants Inc.

Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

To find more *Research Highlights* plus a wide variety of information products, visit our Web site at

www.cmhc.ca

or contact:

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario
K1A 0P7

Phone: 1 800 668-2642
Fax: 1 800 245-9274

OUR WEB SITE ADDRESS: www.cmhc.ca

Although this information product reflects housing experts' current knowledge, it is provided for general information purposes only. Any reliance or action taken based on the information, materials and techniques described are the responsibility of the user. Readers are advised to consult appropriate professional resources to determine what is safe and suitable in their particular case. Canada Mortgage and Housing Corporation assumes no responsibility for any consequence arising from use of the information, materials and techniques described.

63745